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Stator Winding Fault Location Tests

Improvements in methods and equipment improve accuracy and reduce testing times and associated costs

What Is The Problem?

Approximately two generator stator winding insulation failures occur per year at Reclamation's 58 hydroelectric powerplants. When this occurs, timely and efficient repairs must be made to return the generator units to service and minimize lost power generation. The value of power lost due to a failure can be as high as \$2,000,000. Existing methods for locating faults are imprecise, and can cause additional damage or have enough uncertainty that undamaged areas are removed or disturbed when repairing the winding.

What Is The Solution?

Reclamation has developed new test equipment and software to detect faults in generator stator windings with a high degree of accuracy. This system will provide Reclamation with an efficient, low cost, option to detect stator winding faults. The system uses a laptop PC, data acquisition system and software, off-the-shelf, clamp-on type current transformers, two specialized hand-held flux probes, and a high-voltage direct-current power supply. The test equipment locates insulation ground wall failures in generator stator windings by tracking pulses of current through the winding to the physical location of the failure. The probes are used to bracket the location of the fault to within one-inch accuracy in most cases. This minimizes uncertainty in determining the precise location of the insulation failure and needed repairs.

This method of nondestructive, positive detection of winding faults results in significant savings by avoiding extended unscheduled outage and lost power generation revenue. The ability to locate faults without the potential for incurring more damage to the surrounding insulation or stator core is another advantage over traditional testing methods.



windings. Power customers can benefit indirectly through reduced power costs resulting from more efficient powerplant operation.

Where Have We Applied This Solution?

Initial field tests of this system were performed when a unique research opportunity arose during a rewind of an existing generator at Crystal powerplant. Several winding faults were simulated in the winding and were successfully located with the new test equipment. In addition, valuable new information characterizing faults deep within the winding was gained for improving the test equipment fault location software.

Future Development Plans

This testing method is suitable for hard-to-locate faults that sustain some amount of voltage and then arc to ground causing generator failure. Ongoing research includes a new method using a clamp-on type direct current micro-ammeter to locate weak/damaged insulation or insulation problems prior to failure. For instance if diagnostic testing indicates a significant weakness in the winding, this new method may be able to track small amounts of applied direct-current to the source of the problem where a highly resistive type fault could occur. This may allow Reclamation to avoid costly in-service failures by repairing/replacing the insulation component prior to failure. This future development is intended to locate insulation problems in new and older windings and have the capability to locate existing faults as well.

More Information

A proceedings manuscript on the subject generator winding fault testing from the 71st Annual International Conference of Doble Clients, 2004, Boston, Massachusetts is available at <http://www.usbr.gov/research/science-and-tech/research/StatorGroundFaultLocatingMethod.pdf>

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Collaborators

Reclamation's Science and Technology Program and the Lower Colorado and Upper Colorado Regional Offices

Who Can Benefit?

Powerplant managers can benefit directly from this technology by making more timely and efficient repairs to damaged